PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : B60R 13/02 — A1

(11) International Publication Number: WO 96/31369

(43) International Publication Date: 10 October 1996 (10.10.96)

(21) International Application Number: PCT/US96/04492

(22) International Filing Date: 2 April 1996 (02.04.96)

(30) Priority Data:
08/416,033 3 April 1995 (03.04.95) US

(71) Applicant: AUTOMOTIVE INDUSTRIES MANUFACTURING INC. [US/US]; 2998 Waterview, Rochester Hills, MI 48309 (US).

(72) Inventors: JOHNSON, David, H.; Apartment #104, 8601 Brooke Park Drive, Canton, MI 48187-4029 (US). BOLLE, William, M.; 3631 Gass Lake Road, Manitowoc, WI 54220 (US). BUCKLEY, Eric, C.; 1718 Foxhill Road, Sheboygan, WI 53081 (US). PETERSON, Theodore, J.; 4319 Morningview Court, Sheboygan, WI 53081 (US).

(74) Agents: COOPER, John, C., III et al.; Foley & Lardner, 35th floor, 777 East Wisconsin Avenue, Milwaukee, WI 53202 (US).

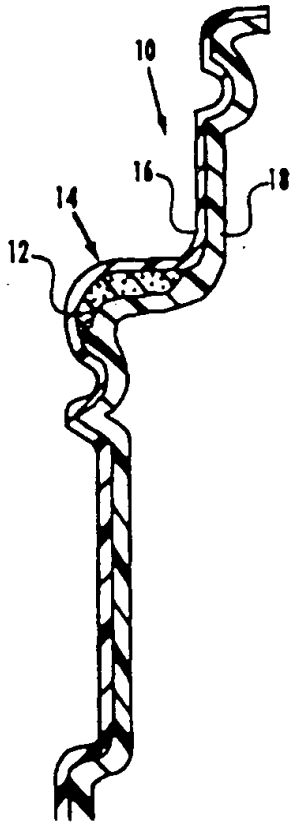
(81) Designated States: CA, DE, GB, JP, KR, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
With amended claims.

(54) Title: MOLDED PLASTIC PANEL HAVING INTEGRATED SOFT-TOUCH ARMREST

(57) Abstract

Plastic automotive interior trim moldings such as door panels, and other components surrounding occupants, are made by integrating a localized elastomeric plastic or flexible-foam plastic (12) between an aesthetic plastic sheet (16) such as vinyl and a structural substrate plastic (18). The method includes forming an integrated armrest in a door panel by first bonding a flexible-foam armrest pad (12) to a plastic cover sheet (16) simultaneous to the forming of the cover sheet (16). The formed cover sheet (16) with attached pad (12), treated as a unit, is subsequently attached to a structural substrate (18) by an in-situ molding which simultaneously forms the substrate (18) and bonds the cover-pad assembly (16, 12) to the substrate (18). The resultant molding possesses the feature of being a unitized door panel (10) that integrates an aesthetic cover (16), a localized soft armrest (14), and a structural substrate (18). The outline of the localized soft area (14) is not visually detectable.



FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia
AT	Austria
AU	Australia
BB	Barbados
BE	Belgium
BF	Burkina Faso
BG	Bulgaria
BJ	Benin
BR	Brazil
BY	Belarus
CA	Canada
CF	Central African Republic
CG	Congo
CH	Switzerland
CI	Côte d'Ivoire
CM	Cameroon
CN	China
CS	Czechoslovakia
CZ	Czech Republic
DE	Germany
DK	Denmark
EE	Estonia
ES	Spain
FI	Finland
FR	France
GB	United Kingdom
GE	Georgia
GN	Guinea
GR	Greece
HU	Hungary
IE	Ireland
IT	Italy
JP	Japan
KE	Kenya
KG	Kyrgystan
KP	Democratic People's Republic of Korea
KR	Republic of Korea
KZ	Kazakhstan
LI	Liechtenstein
LK	Sri Lanka
LR	Liberia
LT	Lithuania
LU	Luxembourg
LV	Latvia
MC	Monaco
MD	Republic of Moldova
MG	Madagascar
ML	Mali
MN	Mongolia
MW	Malawi
MX	Mexico
NE	Niger
NL	Netherlands
NO	Norway
NZ	New Zealand
PL	Poland
PT	Portugal
RO	Romania
RU	Russian Federation
SD	Sudan
SE	Sweden
SG	Singapore
SI	Slovenia
SK	Slovakia
SN	Senegal
SZ	Swaziland
TD	Chad
TG	Togo
TJ	Tajikistan
TT	Trinidad and Tobago
UA	Ukraine
UG	Uganda
US	United States of America
UZ	Uzbekistan

between a vinyl cover and a polyurethane panel substrate. The foam is compressed due to the pressure of molding, e.g. up to about 55 psi, then expands once as the pressure is released. Since the molded back or substrate of the door panel is rigid, the foam presses outwardly against the cover, forming an unsightly visible bulge in the area of the armrest tracing the outline of the armrest cushion.

According to another version of such a product, this outline, or "read line", was eliminated by thickening the cover material so that bulging did not occur. However, such thickening made the armrest stiffer and, to a large extent, defeated the purpose of having a cushion in the first place. When touching this armrest, the user can barely feel that a cushion is present, and the feel of the armrest is essentially rigid like the cover material. Thus, a need persists for a cushioned armrest construction that can be made using injection molding that provides a soft, cushioned feel, yet avoids unsightly bulging caused by rebounding of the cushion.

SUMMARY OF THE INVENTION

A molded plastic panel according to the invention has an integrated, localized elastomeric plastic pad or flexible-foam pad positioned between an aesthetic cover sheet such as vinyl and a rigid, structural plastic substrate. The cover material is sufficiently flexible to yield readily under the weight of a human hand, permitting a person to feel the soft pad underneath. On the other hand, the pad is resilient, but not so resilient that it pushes out against the cover material, forming an unsightly bulge that traces the outline of the pad. The present invention achieves both of these features, particularly in combination with a reaction injection-molded plastic substrate.

According to one aspect of the invention, an integrated armrest is formed in a door panel by first bonding a flexible-foam armrest pad to a plastic sheet

MOLDED PLASTIC PANEL HAVING INTEGRATED SOFT-TOUCH ARMREST

TECHNICAL FIELD

This invention relates to molded plastic panels for automobiles, aircraft and similar interiors, wherein the panels have one or more integrated soft-touch aesthetic features such as an armrest.

BACKGROUND OF THE INVENTION

Interior trim automobile components commonly have cushioned, soft-touch aesthetic features. In particular, automotive interior door panels often have localized cushioned areas in the armrest or bolster area. Such localized softness may be imparted by a flexible-foam or elastomeric pad of varying thickness surrounded by a relatively harder durometer cover sheet material.

A number of processes have been proposed for making cushioned armrests and the like in automotive interior door panels. U.S. Patent No. 5,073,318 for a "Vehicle Inner Panel" discloses a first forming step of molding a substrate layer followed by a second step of molding a foam padding material between the substrate layer and an elastomeric facing layer. U.S. Patent No. 5,224,299 for "Vehicular Door Structure" describes a door trim including a foamed pad member, an outer skin member for covering the foamed pad member, and a framework embedded in the foamed pad member for reinforcing the door trim. U.S. Patent No. 4,474,635 for "Method of Selective Bonding of Textile Materials" teaches a method for compressing the molten surface of a non-woven substrate layer into the interstices of a surface fabric after first positioning a piece of foam cushioning therebetween.

Reaction injection molding is a known process for forming molded articles between male and female mold halves; see BASF U.S. Patent No. 5,208,269. A known interior panel incorporating a cushioned armrest made by reaction injection molding includes a foam pad sandwiched

before, during or after forming of the sheet. It is particularly advantageous to bond the pad to the sheet at the same time as the sheet is formed, since this eliminates the need to perform these operations as separate steps.

The formed sheet with attached pad, treated as a unit, is subsequently attached to a structural substrate by in-situ molding which simultaneously forms the substrate and bonds the cover/pad assembly to the substrate. The resulting molding is a unitized door panel that integrates an aesthetic cover sheet, a localized soft armrest, and a molded plastic panel. During molding, the molding conditions and the characteristics of the materials are adjusted in a manner to effectively eliminate a visible outline of the localized soft area. The localized soft area is thus not visually detectable, but can be easily felt due to its high compressibility. These and other objects, features and advantages of the present invention will become apparent from the following detailed description.

BRIEF DESCRIPTION OF DRAWINGS

The invention will be further described with reference to the accompanying drawings, wherein like numerals denote like elements, and:

Figure 1 shows a plan view of a door panel molding according to the invention having a cushioned armrest;

Figure 2 is a cross-sectional view of the door panel of Figure 1 taken along line 2-2;

Figure 3 is a lengthwise sectional view of the door panel of Figure 1 taken along line 3-3;

Figure 4 is a cross-sectional view of a mold used to form a foam pad for use in the present invention;

Figure 5 is a partial, cross-sectional view of a vacuum forming tool used to form a plastic cover sheet while simultaneously bonding a soft foam pad to the cover sheet; and

Figure 6 is a partial, cross-sectional view of a reaction injection molding apparatus for finishing the panel assembly shown in Figure 5.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Panels for automobile interiors can include localized cushioned areas such as in the armrest or bolster area of a side-trim door, console, instrument panel, and the like. Figures 1 to 3 illustrate a interior molded plastic door panel 10 for a motor vehicle wherein a foam pad 12 is sandwiched between a relatively harder durometer cover material 16 and a rigid plastic substrate 18. Panel 10 is shown in a semi-finished state in which it has openings 13, 15 therein for mounting door hardware, a stereo speaker, and the like.

An armrest 14 according to the invention is formed as a rounded horizontal shelf extending from the rear edge of panel 10 to approximately its center about halfway up panel 10. Pad 12 conforms to the shape of armrest 14, and is preferably generally L-shaped in configuration, so that a bottom edge portion of pad 12 curls down around a rounded sidewall 17 of the armrest. In this manner a passenger can feel the pad on the horizontal top surface of the armrest, or on adjoining surfaces that the passenger's hand may come in contact with.

Cover material 16 conceals pad 12 in a manner effective to conceal the outline of pad 12, shown in dotted lines in Figure 1. This lack of a visible outline in cover material 16 overlying the boundary between soft pad 12 and substrate material 18 may be referred to as "no-read line" construction. Elimination of a read line can be achieved by a variety of measures discussed below dealing with the manner in which panel 10 is made.

Referring now to Figures 4 to 6, an exemplary process of the invention begins with the molding of pad 12 between a first and second mold halves 20, 22. Alternately, pad 12 need not be molded to shape, but may

instead be cut to shape out of elastomeric or foam sheet stock. According to the preferred form of the invention, pad 12 is made of a closed cell foam impermeable to gas and liquid. Such an article may be made from a variety of plastic foam materials such as a solid elastomer, a self-skinning foam, a chemically blown elastomer of closed-cell or microcellular structure, or by having a skin material molded-in during the molding of the article. Examples of such plastics are polyethylene, polypropylene, polyurethane, and polystyrene foams. The preferred closed-cell nature of pad 12 prevents the seepage of liquid urethane into pad 12 during the molding of substrate 18, which can result in loss of softness and uneven degrees of softness in the finished product.

The material of pad 12 is of a density and resiliency to impart a soft feel, yet still be resistant to compression caused by molding pressures. The density of the foam may be from about 4 to 60 pounds per cubic foot (pcf), but preferably from about 12 to 25 pcf in order to minimize the pad's tendency to rebound. If a more compressible and resilient foam material is used, it will have a greater tendency to bulge once substrate 18 molding is completed, while if a less compressible foam is used, it will not exhibit the desired soft-feel effect. For these purposes, the indentation load deflection of the pad (ILD) may be from about 10 to 20 lbs, optimally about 12 lbs.

Pad 12 may have any shape desired for the soft-touch feature in the final product, and may have tapered or squared edges. A gradually tapered or feathered peripheral edge is preferred insofar as such a shape provides a smooth transition from the pad to the underlying rigid substrate and helps provide the no-read line appearance in the finished molding.

Excessive compression of pad 12 should be avoided during the molding of substrate 18 since it may lead to rebound as the part is removed from the mold, causing unsightly distortion. The thickness of pad 12 is

designed to impart softness yet minimize rebound, and for this purpose is typically 0.2 to 2.0 inches thick, most preferably from 0.2 to 0.5 inches thick for door panel applications such as armrests. In general, if pad 12 is too thin it will be insufficiently soft, whereas if pad 12 is too thick, it will have a greater tendency to compress during molding, leading to a greater tendency to rebound.

Once pad 12 is made, an adhesive may be applied directly to its outer surface in the area that will be joined to the back of aesthetic plastic cover sheet 16. The glue should be such that it does not permit pad 12 to pull away from cover sheet 16 to form a gas bubble therebetween. This adhesive may be a solvent-based or water-based adhesive, or a thermoplastic film adhesive. If a thermoplastic film adhesive is used, it can be molded in during the molding of pad 12.

Next, pad 12 with its applied adhesive is placed on a known vacuum-form mold 24, while aesthetic plastic cover sheet 16, such as a vinyl sheet, is heated in a vacuum-forming oven to its molding temperature and simultaneously vacuumed onto mold 24 and pad 12. Pad 12 must, of course, have a sufficiently high temperature resistance so that it will not melt or degrade during molding of the cover sheet. Figure 5 shows mold 24 with pad 12 and cover sheet 16 formed thereto by use of suction applied through vacuum holes 26 in mold 24. The heat contained in plastic cover sheet 16 activates or aids the adhesive bonding, joining pad 12 to cover sheet 16. Heat is applied to the vinyl sheet via a vacuum-forming oven which consists of upper and lower infrared heater banks that heat the sheet from both sides. The foregoing embodiment of the method of the invention is particularly advantageous in that it simultaneously forms the sheet into the required shape and bonds the pad to the inner surface of the sheet, reducing two operations to one.

In a preferred embodiment, plastic cover sheet 16 is comprised of a bilaminate sheet of cross-linked polypropylene foam lining on a flexible vinyl covering material, which is a type conventionally used in automotive interiors. Either a solid or expanded type vinyl skin may be used. Cover sheet 16 has a preferred thickness of from about 0.04 to 0.14 inch (1 to 3.5 mm), typically 0.1 inch, in order to provide sufficient strength and flexibility without excessive rigidity.

As described above, pad 12 is preferably installed during the forming of aesthetic plastic cover sheet 16, eliminating any further steps for installing the soft foam pad. However, plastic cover sheet 16 could be formed by itself on the vacuum form mold, or by a method other than vacuum-forming, and then pad 12 can be attached to cover sheet 16 by an adhesive thereafter. According to a another aspect of the invention, the adhesive is eliminated entirely by inserting cover sheet 16 directly into the mold used to make pad 12 so that cover sheet 16 is bonded to pad 12 at the same time that pad 12 is molded and formed. The urethane reaction that takes place in the foam bonds the pad to the inner surface of cover sheet 16 without need for an adhesive.

In this version of the process, cover sheet 16 is first vacuum formed to the desired shape, and then uncured foam is applied directly to the inner surface of the sheet 16, which inner surface is generally coated with an adhesion promoter in its commercially available form. The sheet may then be placed in a mold in a manner similar to Figs. 4-6, and the foam pad is formed in the presence of the inside of the vinyl sheet. No adhesive is needed because the bond formed between the foam and the inside of the sheet is sufficient to secure the pad to the sheet. Regardless of the process used to make pad 12, at this stage plastic cover sheet 16 and attached pad 12 are treated as a single cover and pad assembly.

Cover-pad assembly 12, 16 is transferred to a reaction injection mold cavity (or an injection mold

cavity) either automatically or by hand. Reaction injection molding (RIM) refers to a molding process in which a reaction takes place within the mold. RRIM using polyurethane, for example, causes the urethane to foam and expand, filling the mold. In reinforced reaction injection molding, the process is similar except that a reinforcing material such as a fiberglass matt is also inserted in the mold and becomes embedded in the molded plastic. These processes differ greatly in practice from conventional injection molding, wherein liquid plastic fed into the mold cools and solidifies without reacting. However, despite the differences between these molding processes, some aspects of the present invention can be used in both injection molding and reaction injection molding, as described further hereafter.

The RIM cavity is located between a first and second halves 30, 32 of a substrate molding tool used for simultaneously molding substrate 18 and bonding the cover-pad assembly thereto by reaction injection molding as shown in Figure 6. Heated substrate material is bonded to the back of cover-pad assembly 12, 16 by in-situ molding so that pad 12 becomes enclosed between plastic cover sheet 16 and plastic substrate 18. Optionally, a mesh of reinforcing material such as fiberglass (not shown) may be laid over the back of cover-pad assembly 12, 16 before the molding of substrate 18 so that the fiberglass becomes embedded in the finished panel.

The substrate molding pressure is typically between about 10 to 100 psi, preferably from about 10 to 30 psi. According to one aspect of the invention, lower molding pressures are preferred because the molding pressure influences the extent of pad 12 compression. Lowering the molding pressure from 55 psi to 20 psi, for example, lessens the tendency of pad 12 to bulge or rebound later on because less compression occurs during molding. For this purpose, the plastic used for molding of substrate 18 to cover-pad assembly 12, 16 is

preferably of a type that can be molded at a low molding pressure. It should have a low viscosity and easy flow characteristics, which can be obtained by adjusting conditions such as the amount of blowing agent, amount of catalyst(s), and monomer content.

Pins 29 mounted on the inside of mold half 30 (see Fig. 6) extend through the mold cavity into one end of pad 12. During molding, pins 29 permit heated, expanding gas in the pad to escape. It has been found according to the invention that relieving gas pressure in this manner reduces the tendency of the pad to bulge. In the illustrated embodiment, several pins 29 are disposed at spaced positions, e.g. 1-2 inches apart, along the length of pad 12. Pins 29 need not be tubular; the gas escapes along the outside of pins 29 during the molding process. When the part is removed from the mold, small air passages extending through the molded substrate remain.

Another technique for lowering the molding pressure is to overclose or underclose the mold for a period of time during the molding of substrate 18. In the former case, the mold is overclosed to distribute the liquid reagents throughout the cavity more completely than would occur without overclosing. When a plastic has to flow to fill the mold, a relatively high pressure is needed. Overclosing the mold, for example from a normal gap of 4 mm to 2 mm, fills the mold during the first few seconds of molding when the plastic is at a low viscosity and needs only low pressure to move it through the cavity. After a few seconds the mold is reopened to its normal position, e.g., 4 mm, and the material reacts and fills the rest of the mold. Overclosing is discontinued while the reactants are still somewhat fluid, resulting in a lower peak molding pressure. This technique is effective in regular injection molding as well as for RIM and RRIM procedures.

A similar effect can be obtained by underclosing the mold during the initial stage of

molding. In either case, the molding step generally lasts from about 45 to 120 seconds, and the period for overclosure or underclosure lasts from about 2-10 seconds.

To carry out the step of molding the substrate 18, a typical substrate molding tool used in molding rigid, low-density, reinforced or unreinforced structural blown polyurethane may be used. The mold may also be of the compression-molding type which molds a filled thermoplastic sheet into an interior-trim substrate while simultaneously bonding the substrate to the cover-material assembly. This is known as the Woodstock™ molding process as described in U.S. Patent No. 4,228,116. Alternately, the mold can be of the injection-molding thermoplastic type. An advantage common to each of the above substrate molding processes is that the space required for pad 12 is minimized because substrate 18 is molded to the exact contour of the back side of cover-pad assembly 12, 16 without concern as to tolerances or the need for space to attach devices or secondary pieces for retaining the armrest. The latter advantage is important because space is scarce in car door constructions.

It should also be noted that the molded substrate bonds to pad 12 and cover sheet 16 during molding. The nature of such a bond is different than one formed, for example, by forming substrate 18 separately and then gluing it to the assembly of the cover sheet and pad. The bond is inherently cohesive, and is superior to an adhesive bond. Thus, the foregoing process of the invention gives rise to a physically unique and improved product.

It is also possible to intentionally distort the skin-side mold surface in the soft touch area in a manner effective to prevent bulging of the foam pad after molding. This can be done by, for example, providing a sliding, adjustable mold component that pushes in on the foam pad and vinyl skin in the area of the pad,

compressing the pad and forming an indentation during molding. Later, once the substrate has solidified, the molded piece is removed from the mold and the pad bulges out, but only to its normal position, not to the extent that a read-line is formed. In this technique, the intentional distortion of the pad compensates for the rebound that occurs after removal from the mold.

After substrate 18 is molded, the three components of aesthetic cover 16, pad 12, and substrate 18 are substantially unitized by cohesive plastic bond interfaces. Since pad 12 is installed prior to or during the forming of substrate 18, molded panel 10 having integrated localized soft-touch features and a visibly undetectable border between softness and relative hardness is complete when it leaves the mold and requires no further finishing operations, except for operations unrelated to the soft touch feature.

The invention will be further described in the following example.

EXAMPLE

A soft armrest foam pad was molded from a microcellular water-blown flexible foam polyurethane. This system calls for mixing 81 parts isocyanate with 100 parts resin. The two chemicals were heated to 80°F and injected at 1,500 psi via a high pressure polyurethane delivery system into a mold cavity heated to 130°F. The foam pad was removed from the mold after 3 minutes.

This foam pad was then sprayed with a pressure sensitive water-based acrylic adhesive. The water solvent was flashed off at 160°F for 3 minutes. Next, the foam pad with applied adhesive was placed on a vacuum, male-form mold with the glue-side out. An expanded vinyl skin was heated in an oven to a surface temperature of 300°F and transferred to the vacuum mold. As vacuum was applied, the skin was formed to the mold shape and simultaneously bonded to the foam pad. The vinyl remained on the mold for 15 seconds, a sufficient

time so that the plastic could cool to a temperature below its forming temperature of 150°F.

The skin with attached foam was removed from the vacuum tool and transferred to a mold installed in a molding clamp. The vinyl was then placed in the female cavity half of the mold, and a sheet of fiberglass mat, weighing 1 oz. per square foot, was placed atop the vinyl. Additional injection molded plastic attachments, i.e. devices for locating points of attachment and attaching the door panel to the vehicle door, were inserted in the male cavity half of the mold.

The mold was closed to within one inch of being fully closed. Polyurethane liquid reagents were injected into the mold cavity through a high-pressure pour system. After a delay of two seconds, the clamp closed the mold completely. The reagents then foamed and expanded to fill the mold cavity and reacted to form rigid polyurethane. After 60 seconds, the mold was opened and the molding consisting of vinyl, foam pad, rigid glass-reinforced polyurethane and attachments was removed.

It will be understood that the foregoing description is of preferred exemplary embodiments of the invention, and that the invention is not limited to the specific forms shown. For example, soft touch features other than armrests could readily be made using the method of the invention. This and other modifications may be made in the design and arrangement of the elements without departing from the scope of the invention as expressed in the appended claims.

CLAIMS:

1. An automotive interior panel, comprising:

an injection-molded, rigid plastic substrate configured to fit onto the inside of a vehicle door and having a shelf configured as an armrest;

a cover secured to an outer face of the substrate, the cover having sufficient flexibility to yield readily under the weight of a human hand; and

a pad of resilient foam material disposed on the shelf of the substrate and closely secured between and encapsulated by the substrate and the cover, the pad and a portion of the cover overlying the pad providing a soft, compressible cushion for the armrest without a visible outline of the pad being visible on the cover.

2. The panel of claim 1, wherein the soft foam pad has one or tapered peripheral edges.

3. The panel of claim 1, wherein the soft foam pad is made of a closed-cell foam impermeable to liquid plastic used to form the substrate.

4. The panel of claim 3, wherein the soft foam pad has a thickness of from about 0.2 to 2.0 inches, a density of from about 4 to 60 pounds per cubic foot, and an indentation load deflection from about 10 to 20 lbs.

5. The panel of claim 3, wherein the soft foam pad has a thickness of from about 0.2 to 0.5 inch, a density of from about 4 to 25 pounds per cubic foot.

6. A process for making an automotive interior panel that integrates an aesthetic cover sheet, a localized soft pad, and a structural substrate, comprising the steps of:

(A) forming a flexible sheet of a cover material into a shape of an automotive interior panel to form the cover sheet;

(B) bonding a compressible plastic foam pad to the flexible cover sheet; and

(C) attaching the sheet-pad assembly to a structural substrate by in-situ molding which simultaneously forms the substrate and bonds the cover-pad assembly to the substrate.

7. The process of claim 6, further comprising, prior to step (A), a step of molding the foam pad and simultaneously applying a film of adhesive to the foam pad during molding.

8. The process of claim 6, wherein steps (A) and (B) further comprise:

coating an outer face of the pad with an adhesive; and

vacuum-forming the cover sheet to a predetermined shape, thereby bonding the adhesive-coated face of the pad to the cover sheet.

9. The process of claim 6, further comprising, prior to step (A), the steps of:

inserting the sheet of cover material into a mold; and

forming the foam pad by molding in the presence of the sheet of cover material so that the foam pad becomes cohesively bonded to the sheet of cover material.

10. The process of claim 6, wherein the step of attaching the sheet-pad assembly to the structural substrate by in-situ molding further comprises initially overclosing the mold, then opening the mold to its correct molding position while the substrate is still fluid.

11. The process of claim 6, wherein the step of attaching the sheet-pad assembly to the structural substrate by in-situ molding further comprises initially underclosing the mold, then closing the mold to its correct molding position while the substrate is still fluid.

12. The process of claim 6, wherein the step of attaching the sheet-pad assembly to the structural substrate by in-situ molding further comprises compressing the sheet-pad assembly from outside during molding to an extent sufficient to compensate for rebound of the compressed pad after removal from the mold.

13. The process of claim 12, wherein the sheet-pad assembly is compressed by indentation with a projection on a substrate mold.

AMENDED CLAIMS

[received by the International Bureau on 19 August 1996 (19.08.96); original claims 1-13 replaced by amended claims 1-19 (5 pages)]

1. An automotive interior panel comprising:

an injection-molded, rigid plastic substrate configured to fit onto an inside of a vehicle door and having a shelf configured as an armrest;

a cover secured to an outer face of the substrate, the cover having sufficient flexibility to yield readily under the weight of a human hand; and

a pad of resilient foam material covering part of the outer face of the substrate, which pad is disposed on the shelf of the substrate and closely secured between and encapsulated by the substrate and the cover along an outer peripheral edge of the pad, the cover covering the outer peripheral edge of the pad at an inwardly facing portion of the interior panel, so that the pad and a portion of the cover overlying the pad provide a soft, compressible cushion for the armrest without a visible outline of the pad being visible on the cover along the outer peripheral edge of the pad.

2. The panel of claim 1, wherein the pad is made of a closed-cell foam impermeable to liquid plastic used to form the substrate.

3. The panel of claim 3, wherein the pad has a thickness of from about 0.2 to 2.0 inches, a density of from about 4 to 60 pounds per cubic foot, and an indentation load deflection from about 10 to 20 lbs.

4. The panel of claim 3, wherein the pad has a thickness of from about 0.2 to 0.5 inch and a density of from about 4 to 25 pounds per cubic foot.

5. The panel of claim 1, wherein the pad is disposed on the shelf of the substrate and closely secured between and encapsulated by the substrate and the cover in a substantially uncompressed state.

6. The panel of claim 5, wherein the panel has been made by a process comprising the steps of:

(A) forming a flexible sheet of a cover material into a shape of an automotive interior panel to form the cover;

(B) bonding the pad to the cover to form a sheet-pad assembly;

(C) attaching the sheet-pad assembly to the substrate by in-situ molding which simultaneously forms the substrate and bonds the cover-pad assembly to the substrate; and

(D) preventing compression of the pad during molding of the substrate to an extent sufficient to prevent a visible outline of the pad becoming visible on the cover due to rebound of the pad after molding.

7. The panel of claim 1, wherein the pad is generally L-shaped in cross section along most of its length, and includes a first portion covering the armrest shelf and a second portion that curves over an edge of the armrest shelf.

8. The panel of claim 7, wherein the pad is configured to cover only the armrest shelf and a portion of the substrate just below the edge of the armrest shelf.

9. The panel of claim 1, wherein the cover comprises a flexible vinyl material have a thickness in the range of about 0.04 to 0.14 inch.

10. The panel of claim 1, wherein at least a portion of the outer peripheral edge of the pad is tapered.

11. An automotive interior panel comprising:

an injection-molded, rigid plastic substrate configured to fit onto an inside of a vehicle door and having a shelf configured as an armrest;

a cover secured to an outer face of the substrate, the cover having sufficient flexibility to yield readily under the weight of a human hand; and

a pad of resilient foam material disposed on the shelf of the substrate and closely secured between and encapsulated by the substrate and the cover along an outer peripheral edge of the pad, the pad being configured to cover only an armrest portion of the substrate including the shelf and an area of the outer face of the substrate proximate the shelf, the remainder of the outer face of the substrate being free of the pad, the pad and a portion of the cover overlying the pad providing a soft, compressible cushion for the armrest portion without a visible outline of the pad being visible on the cover along the outer peripheral edge of the pad.

12. A process for making an automotive interior panel that integrates an aesthetic cover sheet, a localized soft pad, and a structural substrate, comprising the steps of:

(A) forming a flexible sheet of a cover material into a shape of an automotive interior panel to form the cover sheet;

(B) bonding a compressible plastic foam pad to the flexible cover sheet; and

(C) attaching the sheet-pad assembly to a structural substrate by in-situ molding which simultaneously forms the substrate and bonds the cover-pad assembly to the substrate.

13. The process of claim 12, further comprising, prior to step (A), a step of molding the foam pad and simultaneously applying a film of adhesive to the foam pad during molding.

14. The process of claim 12, wherein steps (A) and (B) further comprise:

coating an outer face of the pad with an adhesive; and

vacuum-forming the cover sheet to a predetermined shape, thereby bonding the adhesive-coated face of the pad to the cover sheet.

15. The process of claim 12, further comprising, prior to step (A), the steps of:

inserting the sheet of cover material into a mold; and

forming the foam pad by molding in the presence of the sheet of cover material so that the foam pad becomes cohesively bonded to the sheet of cover material.

16. The process of claim 12, wherein the step of attaching the sheet-pad assembly to the structural substrate by in-situ molding further comprises initially overclosing the mold, then opening the mold to its correct molding position while the substrate is still fluid.

17. The process of claim 12, wherein the step of attaching the sheet-pad assembly to the structural substrate by in-situ molding further comprises initially underclosing the mold, then closing the mold to its correct molding position while the substrate is still fluid.

18. The process of claim 12, wherein the step of attaching the sheet-pad assembly to the structural substrate by in-situ molding further comprises compressing the sheet-pad assembly from outside during molding to an extent sufficient to compensate for rebound of the compressed pad after removal from the mold.

19. The process of claim 18, wherein the sheet-pad assembly is compressed by indentation with a projection on a substrate mold.

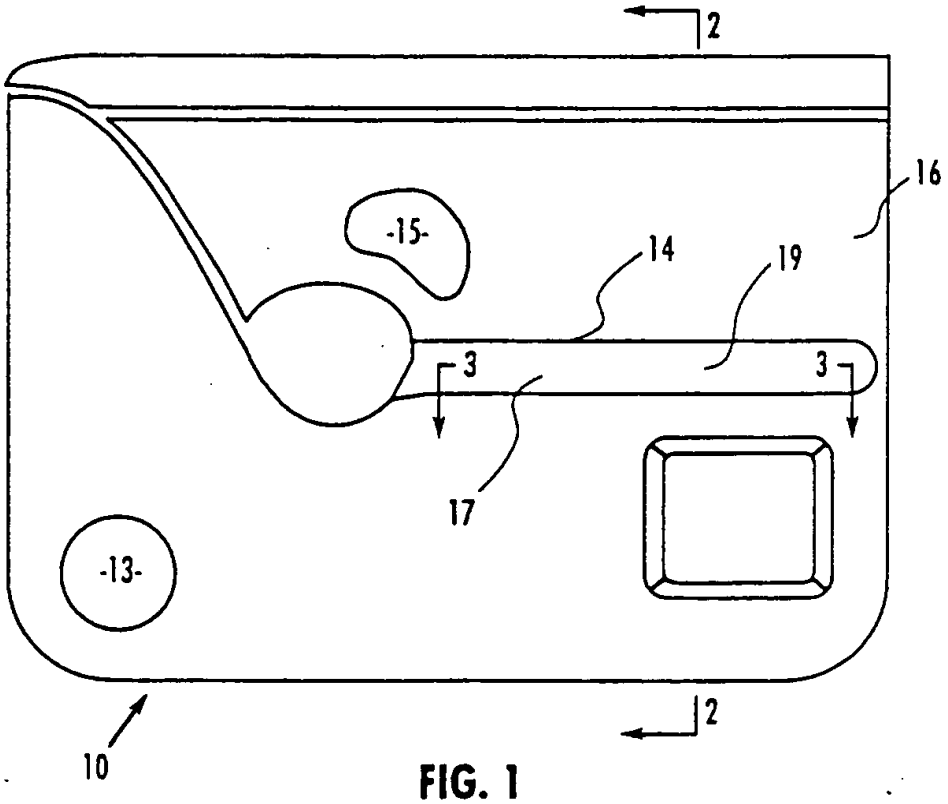


FIG. 1

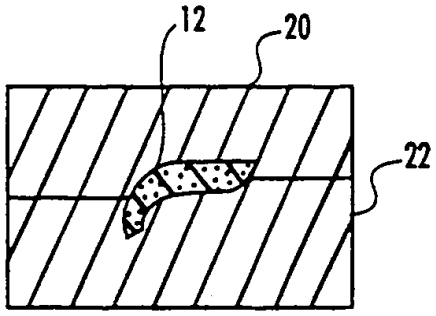


FIG. 4

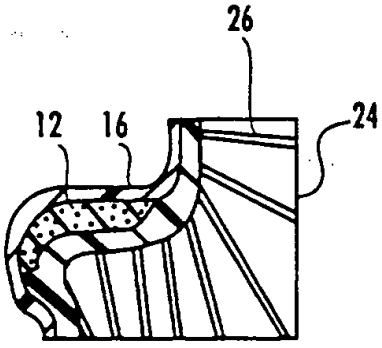


FIG. 5

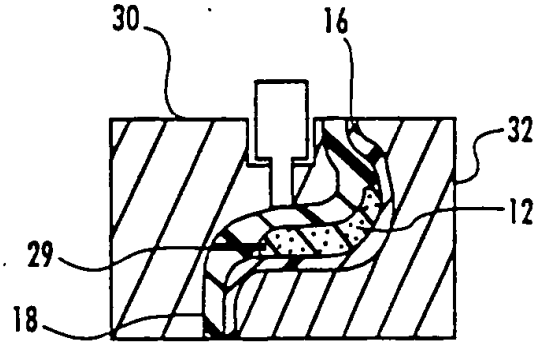


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/04492

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Please See Extra Sheet.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-5

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/04492

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING
This ISA found multiple inventions as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1-5, drawn to a panel; and
Group II, claims 6-13, drawn to a process.

The inventions listed as Groups I and II do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

For Group I: a panel having a cover and a pad in which a portion of the cover overlying the pad provides a cushion without a visible outline of the pad being visible on the cover.
For Group II: a process in which the sheet-pad assembly is attached to a structural substrate by in-situ molding which simultaneously forms the substrate and bonds the assembly thereto.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/04492

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :B60R 13/02
US CL :296/146.7, 153
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 296/146.7, 153; 49/502

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US, A, 3,989,275 (FINCH ET AL.) 02 NOVEMBER 1976 See entire document.	1-5
X	US, A, 5,040,335 (GRIMES) 20 AUGUST 1991 See entire document.	1-5
X	JP, A, 4-169346 (TSUBOSAKI ET AL.) 17 JUNE 1992 See entire document.	1-5

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 MAY 1996	19 JUN 1996
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT	Authorized officer ANDREW C. PIKE

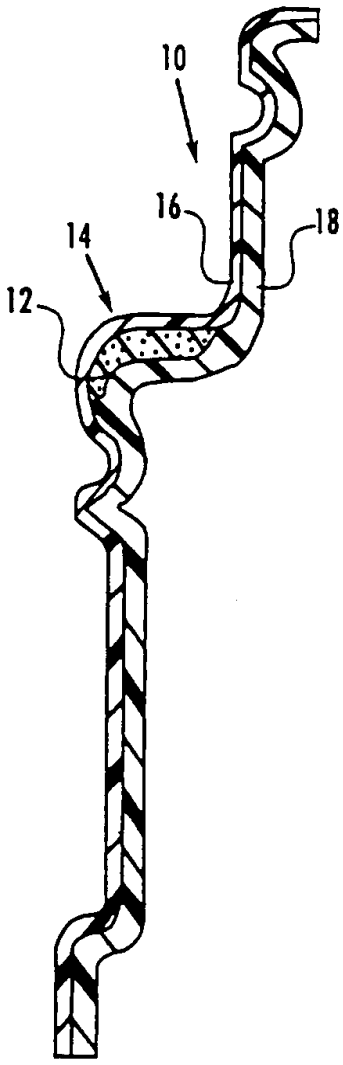


FIG. 2

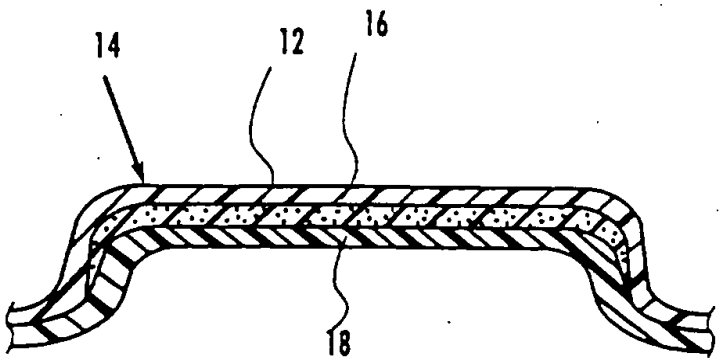


FIG. 3